EPJE

as of 4 May 2004

Description document subject to change

Charts Summarizing Meeting Discussions on development of JITC testing protocols

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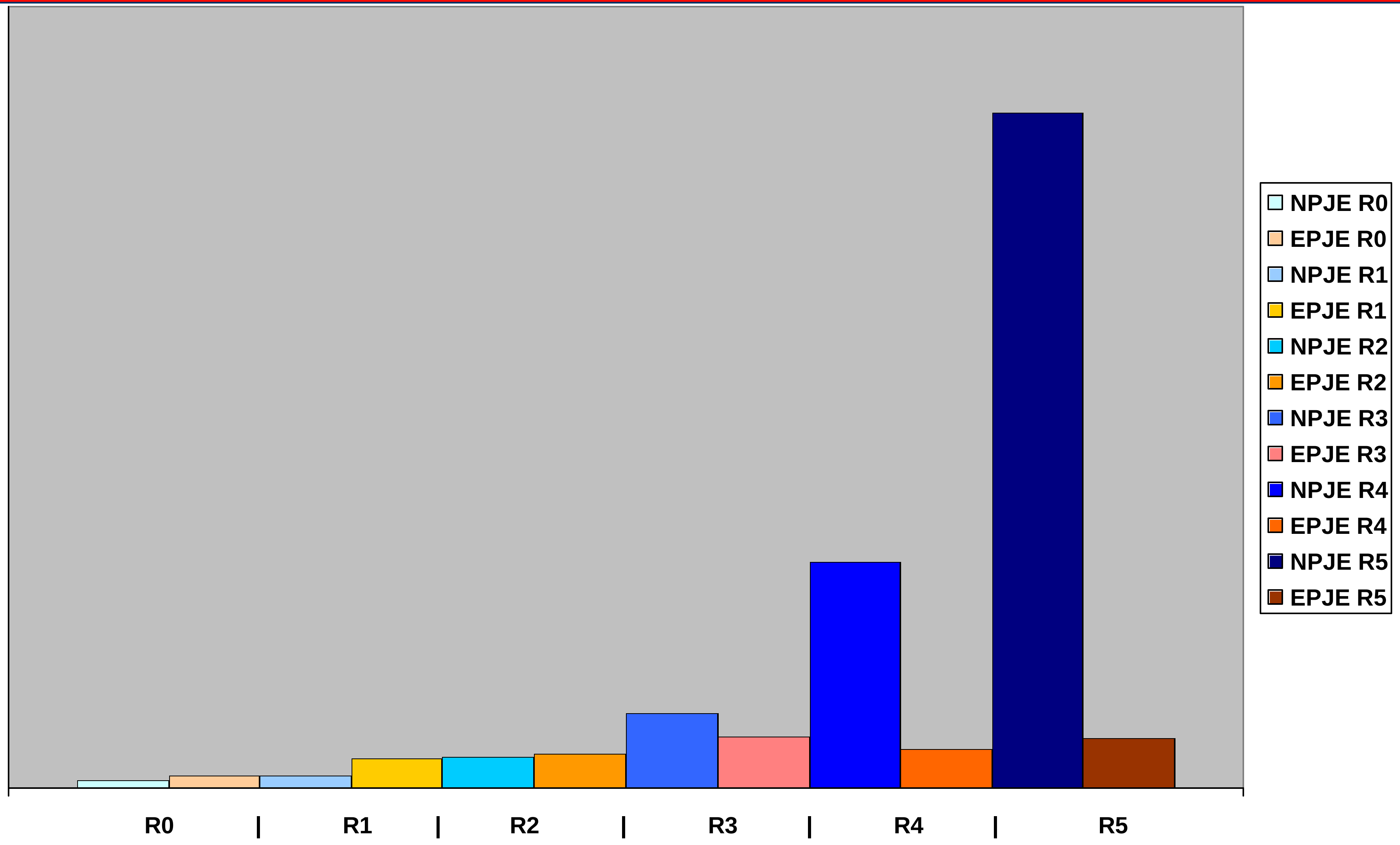
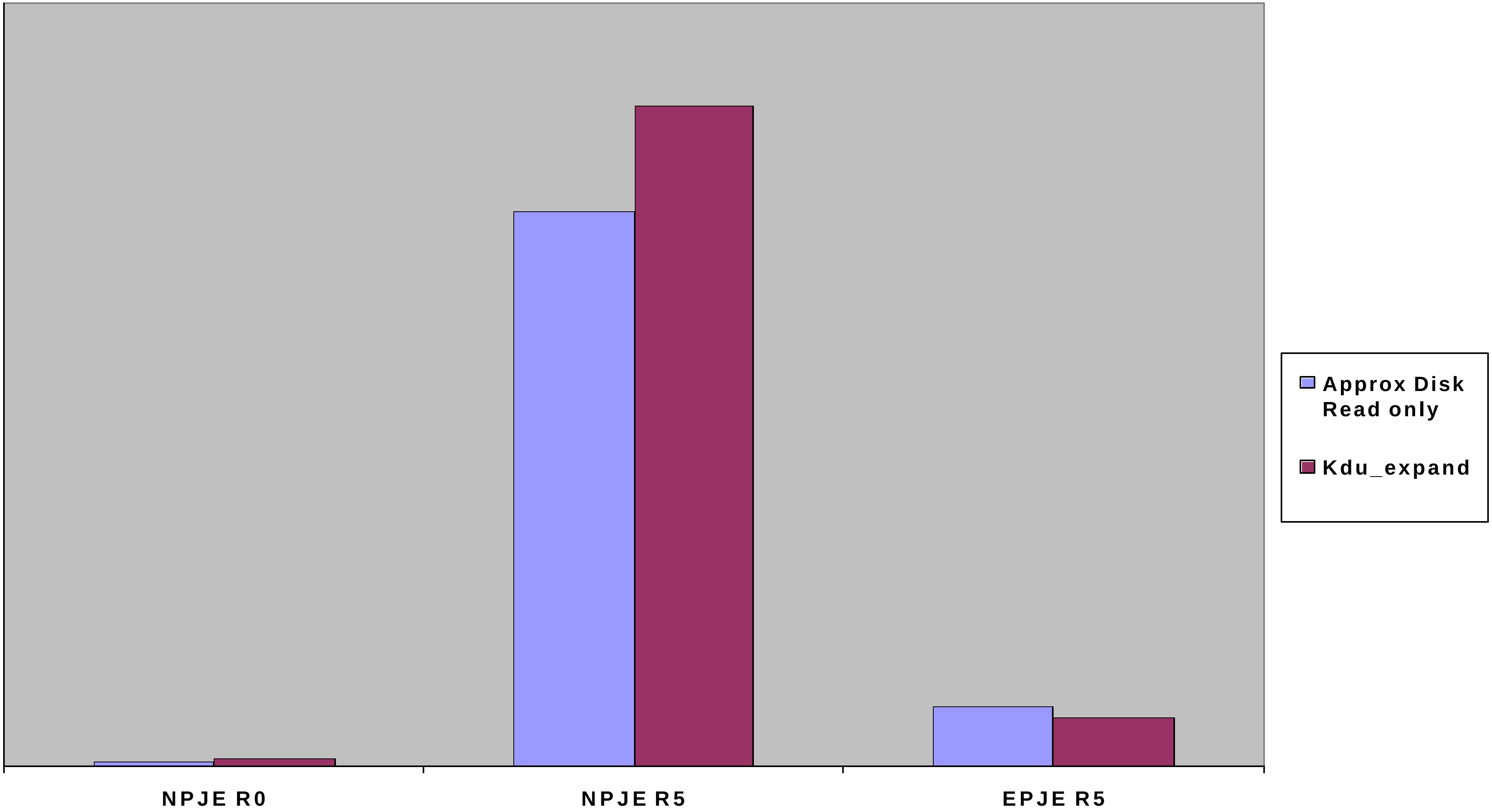
What is EPJE?

- Exploitation Preferred JPEG 2000 Encoding
- Improved access time for lower resolutions in *large* images
- Based upon NPJE
  - NPJE: Described in BIIF J2K Profile (ISO SC 24)
  - NPJE <==> EPJE conversion done without unpacking any packets
  - Identical decoded data
- Testing Design
  - JITC (Joint Interoperability Test Center) lead
    - input from vendors/contractors with J2K testing experience
  - EPJE format understanding: key

Kdu_expand v4.2 for 1024x1024 pixels: with Disk access



Disk I/O Limits on Expansion time (1Kx1K image chip)



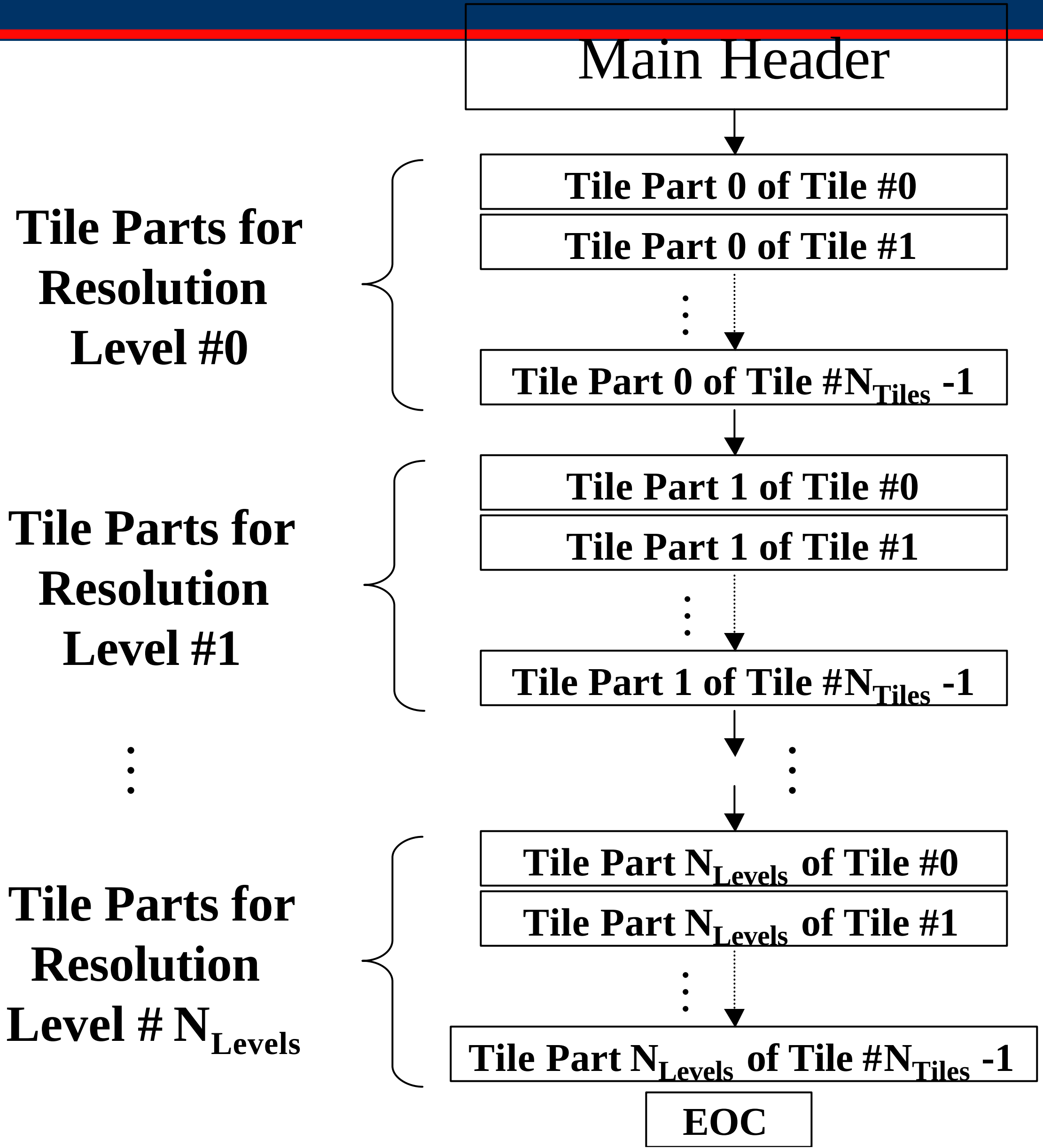
Where EPJE = NPJE

- SIZ
  - tiling (1024x1024), subsampling (1,1)
- Most of COD
  - i.e. maximal precincts
  - but not Progression order
- QCD
- QCC
- Most of SOT -- but not TPsot, TNsot
- SOD
- EOC

Where EPJE 1 NPJE

- HighLevel Codestream Layout
  - Multiple Tileparts per Tile
  - One tilepart per resolution level
- COD Progression order = RLCP (0000 0001)
- TLM
  - Format: ST=2, SP=1, ie Stlm = 0110 0000
  - Multiple TLMs allowed
- 2nd-last Tile part Headers differ from 1st
- PLT division: Only one PLT per tile-part
- No other markers allowed: COM, POC, ...
- Marker order fixed

EPJE High Level Layout



Main Header

Tile Parts for Resolution Level #0

Tile Part 0 of Tile #0

Tile Part 0 of Tile #1

⋮

Tile Part 0 of Tile #N_{Tiles} -1

Tile Parts for Resolution Level #1

Tile Part 1 of Tile #0

Tile Part 1 of Tile #1

⋮

Tile Part 1 of Tile #N_{Tiles} -1

⋮

Tile Parts for Resolution Level # N_{Levels}

Tile Part N_{Levels} of Tile #0

Tile Part N_{Levels} of Tile #1

⋮

Tile Part N_{Levels} of Tile #N_{Tiles} -1

EOC

Components must appear in order shown

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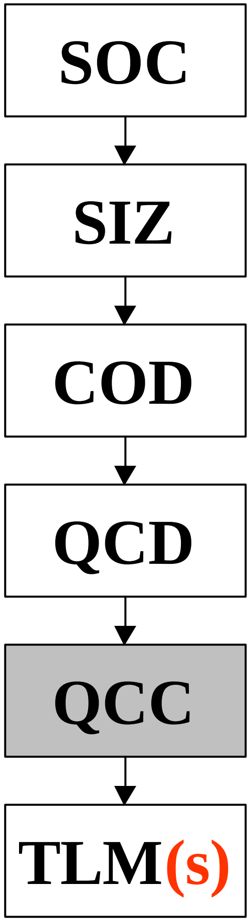
EPJE Main Header Layout

Components must appear in order shown



See EPJE COD format

optional

Use as many TLMs as necessary.
See EPJE TLM format

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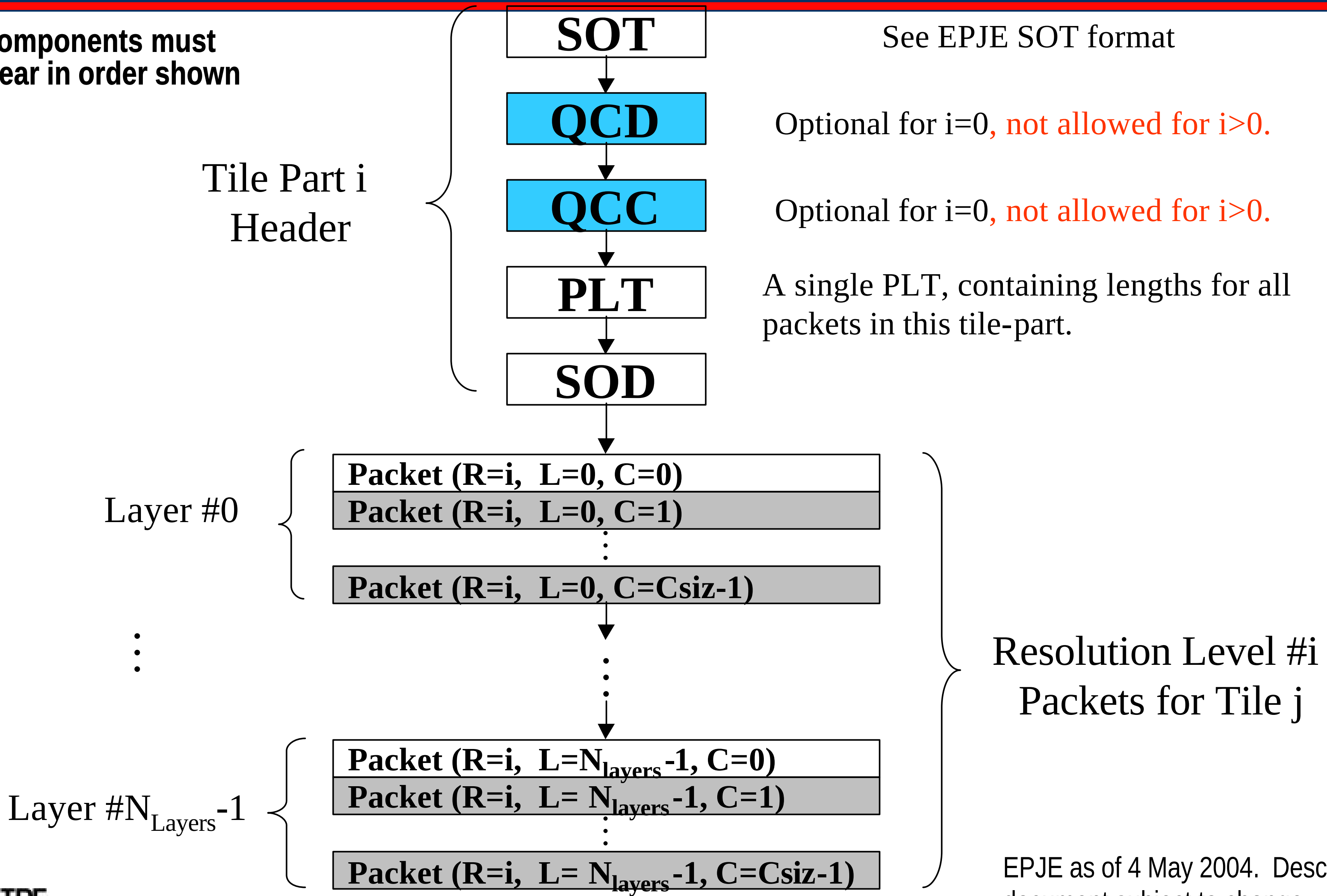
Tile Part i for Tile #j

Components must appear in order shown



Tile Part i Header

SOT — See EPJE SOT format

QCD — Optional for i=0, not allowed for i>0.

QCC — Optional for i=0, not allowed for i>0.

PLT — A single PLT, containing lengths for all packets in this tile-part.

SOD

Layer #0

Packet (R=i, L=0, C=0)

Packet (R=i, L=0, C=1)

⋮

Packet (R=i, L=0, C=Csiz-1)

⋮

Layer #N_{Layers}-1

Packet (R=i, L=N_{layers}-1, C=0)

Packet (R=i, L= N_{layers}-1, C=1)

⋮

Packet (R=i, L= N_{layers}-1, C=Csiz-1)

Resolution Level #i Packets for Tile j

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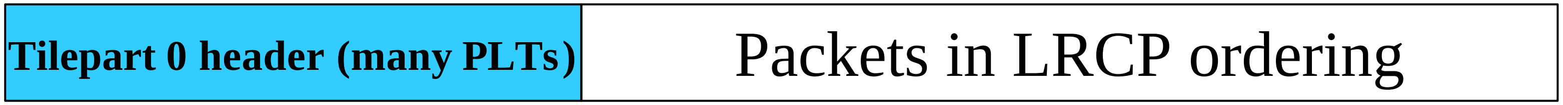
EPJE vs NPJE Tile

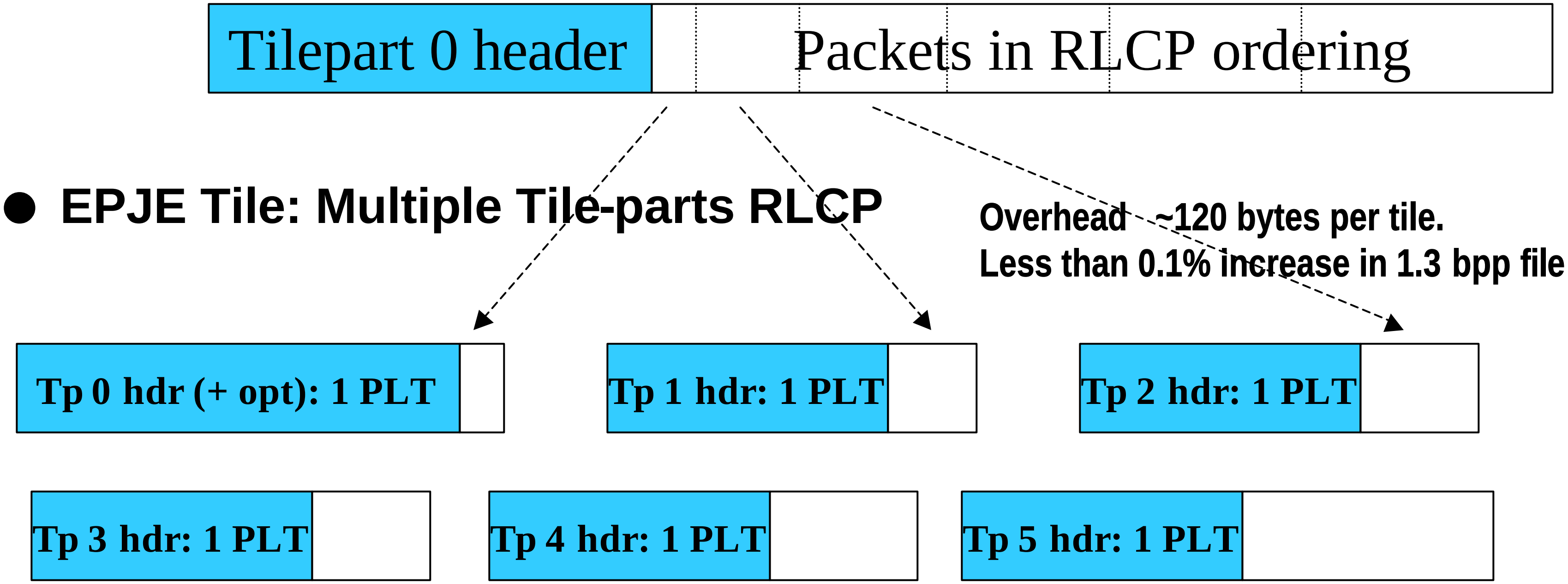
- NPJE Tile: 1 Tile-part



Tilepart 0 header (many PLTs)

Packets in LRCP ordering

- RLCP: 1 Tile-part



Tilepart 0 header

Packets in RLCP ordering

- EPJE Tile: Multiple Tile-parts RLCP

Overhead ~120 bytes per tile.
Less than 0.1% increase in 1.3 bpp file

Tp 0 hdr (+ opt): 1 PLT

Tp 1 hdr: 1 PLT

Tp 2 hdr: 1 PLT

Tp 3 hdr: 1 PLT

Tp 4 hdr: 1 PLT

Tp 5 hdr: 1 PLT

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EPJE SOT

Parameter	Size (bits)	Values	NPJE	EPJE	Notes
SOT	16	0xFF90	0xFF90 (Required)	0xFF90 (Required)	Start of tile part marker code
Lsot	16	10	10	10	Length of marker segment
Isot	16	0 – 65 534	Tile index	Tile index	Tile index in raster order starting at index 0
Psot	32	0, 14 – (2^{32} –1)	Length of tile-part 0, 14 – (2^{32} –1)	Length of **tile-part** 0, 14 – (2^{32} –1)	The length in bytes from the beginning of SOT marker segment of the tile-part to the end of the data of that tile-part. It is recommended a Psot of 0 be replaced by the actual tile length when a JPEG 2000 codestream is incorporated into NSIF. If Psot=0 is maintained in an NSIF file, the current tile part will be interpreted to extend to the end of the current NSIF image segment.
TPsot	8	0 - 254	**0**	**0 – N_{Levels}***	Tile-Part index.
TNsot	8	0 - 255	**1**	**N_{Levels}+1**	0 = Number of tile-parts of this tile in the codestream is not defined in this header 1 – 255 number of tile-parts of this tile in the codestream

*** Boldface draws attention to contents that are differ between NPJE and EPJE.**

EPJE COD

Parameter	Size (bits)	Values	NPJE	EPJE	Notes
COD	16	0xFF52	0xFF52	0xFF52	Coding style default marker.
Lcod	16	Maximal precincts: Lcod = 12 User-defined precincts: Lcod = 13 + N_{Levels}	12	12	Length of this marker segment in bytes (not including the marker).
Scod	8	0000 0000 – 0000 0111	0000 0000	0000 0000	Entropy coder with maximum precinct size. No SOP marker segments shall be used. EPH marker shall not be used.
SGcod	32	Defined below			
Progression order	8	0000 0000 – 0000 0100	**0000 0000** (as defined by Table 7-9)	**0000 0001** (as defined by Table 7-9)	Resolution level-layer-component-position progression provides resolution progression.

Remainder of COD is identical to NPJE

EPJE TLM

Parameter	Size (bits)	Values	NPJE	EPJE	Notes
TLM	16	0xFF55	0xFF55	0xFF55	Tile-part lengths marker.
Ltlm	16	$Ltlm = \begin{array}{lcc} & \underline{ST} & \underline{SP} \\ \left\{\begin{array}{l} 4+2\cdot N_{tpm} \\ 4+3\cdot N_{tpm} \\ 4+4\cdot N_{tpm} \\ 4+4\cdot N_{tpm} \\ 4+5\cdot N_{tpm} \\ 4+6\cdot N_{tpm} \end{array}\right. & \begin{array}{c} 0 \\ 1 \\ 2 \\ 0 \\ 1 \\ 2 \end{array} & \begin{array}{c} 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \end{array} \end{array}$ N_{tpm} = number of tile-parts in this TLM marker segment	**ST = 0**, SP = 1 Ltlm = 4 + **4**·N_{tiles} (8 – 65535)	**ST = 2**, SP = 1 Ltlm = 4 + **6**·N_{tiles} (8 – 65535)	Length of this marker segment in bytes (not including the marker). For this profile, the number of tile parts in the marker segment is equal to the number of tiles.
Ztlm	8	0 – 255	**0**	**0 – 255**	**As many TLMs as required** to contain all tile-part length info.
Stlm	8	0000 0000 – 0110 0000	**0100 0000**	**0110 0000**	ST = 2; multiple tile-parts, 16-bits for each Ttlm. SP = 1; Ptlm parameter has 32 bits.
$Ttlm^i$	0 if ST = 0 8 if ST = 1 16 if ST = 2	Tiles in order 0 – 254 0 – 65 534	**NA**	**0 — 65534**	Tile index for each Tile-part. Tile-parts appear in raster order within each resolution section.
$Ptlm^i$	16 if SP = 0 32 if SP = 1	14 – 65 535 14 – (2^{32} – 1)	14 — (2^{32}-1)	14 — (2^{32}-1)	The length, in bytes, from the beginning of the SOT marker of the i^{th} **tile-part** to the end of the codestream data for that **tile-part**. There should be one Ptlm for every tile-part. *

*** For EPJE there is more than one tile-part per tile.**

EPJE PLT

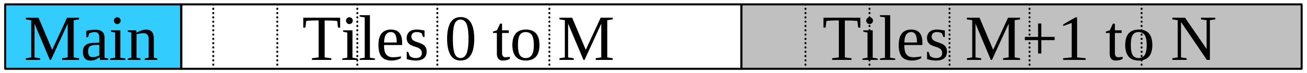
Parameter	Size (bits)	Values	NPJE	EPJE	Notes
PLT	16	0xFF58	0xFF58	0xFF58	Packet length, tile-part header, marker.
Lplt	16	4 — 65535	4 — 65535	4 — 65535	Length of this marker segment in bytes (not including the marker).
Zplt	8	0 — 255	0**— 18**	**0**	Index of this marker segment relative to all other PLT marker segments in the current header.
Iplt^i	8 bits repeated as necessary See ISO/IEC IS15444-1: Table A-36	0000 0000 – 1111 1111	0xxx xxxx	0xxx xxxx	Signals that the next seven bits are the last bits indicating the length of the ith packet.
			1xxx xxxx	1xxx xxxx	Signals that there are further bits to be included after these next seven bits are included as part of the packet length.
			x000 0000 — x111 1111	x000 0000 — x111 1111	7 bits of packet length. All bits associated with the length of the ith packet are concatenated and right justified in the order in which they appear. The packet length shall include the packet header.

J2KLRA

- ORIG Field
  - 2 => EPJE format, all original bitstream (ie all packets remain)
  - 3 => EPJE format, parsed data (some original packets gone)
- Other fields
  - Same as NPJE

Known EPJE Format Errors: Test Candidates

- Incorrectly formatted EPJE, when
  - Contains
    - COM, RGN, POC, PLM, PPT, or CRG
  - Markers out of expected order
  - TLM with incorrect ST/SP values
  - SOT with TNsot = 0
  - Progression = RPCL
  - EPJE by subset



Main | Tiles 0 to M | Tiles M+1 to N

- Happens if compressed data is periodically flushed during generation

Next Steps

- Devise tests for
  - EPJE encoding
    - Check EPJE format
  - EPJE transcoding
    - Check EPJE format
    - Compare NPJE input with EPJE output
  - EPJE decoding
    - Subset of generic J2K Part 1 Profile 1 decode test
- Keep tests current with EPJE description